REMARKS

Due to the length of the specification herein, Applicants will cite to the paragraph number of the published patent application (PG Pub) of the present application, i.e., US 2004/0055676, when discussing the application description, rather than to page and line of the specification as filed.

The rejection of Claims 8-12 and 14-17 under 35 U.S.C. § 103(a) as unpatentable over US 5,348,702 (Masahashi et al), is respectfully traversed.

As previously argued, the present invention relates to a process for manufacturing TiAl alloy by hot-working, i.e., high-speed plastic working, while Masahashi et al is related to a process for manufacturing super plastic materials by isothermal-forging. In hot-working, material is taken out of a furnace after heating and is made plastic at a high distortion speed with a hydraulic press etc. outside of the furnace while being cooled. This process is highly productive and practical. In contrast to this, with isothermal forging, material is made plastic at a low distortion speed with a processing machine having heating and heat retention functions while being heated. Although this process enables the plasticity processing of materials which are hard to process, productivity is low.

The Examiner finds that removing material from the homogenizing furnace of Masahashi et al prior to hot working would have been obvious because Masahashi et al does not specify that thermomechanical treatment is performed in their homogenizing furnace and/or the working temperature is lower than the homogenization temperature.

In reply, considering the small size of a test piece used in Masahashi et al, it is practically impossible to conduct, without heating, thermomechanical working of the small-sized test piece at such a low cooling rate (10K/min.) as disclosed by Masahashi et al. In other words, thermomechanical working is conducted in a certain device such as a furnace to heat a test piece, and these processes are ordinarily carried out for conventional TiAl alloys.

In the present invention, as recited in the pending claims, the cooling rate is set to a range between 50 to 700 °C/min., which is significantly higher than the value of Masahashi et al. In addition, and as exemplified in Example 1 herein, the material is subjected to a high-speed plastic working at a high pressure, such as with aid of a press of 2800 tons [0099]. When such a press is used in the present invention, the press speed is 100 mm/sec or higher, which is much larger than an exemplary value of Masahashi et al of 0.0042 mm/s. (The value 0.0042 mm/sec can be obtained by an equation: 42 mm X 10^{-4} sec^{-1}, since a test piece (cylindrical ingot) of 42 mm length, which was used in the examples of Masahashi et al, was subjected to isothermal forging at a strain rate of 10^{-4} sec^{-1} (column 9, lines 35-40). By employing such a strain rate, together with the lowest cooling rate of 50 °C/min according to the present invention, isothermal forging from 1400 °C to 1200 °C would take 4 minutes, which is much longer than it takes in the present invention, such as 30 seconds for above-discussed Example 1 [0099]. The working ratio in Masahashi et al under such conditions is only 2.4% at maximum. Therefore, sufficient deformation cannot be obtained. Such a low working ratio indicates that it is impossible to manufacture alloys with high productivity using the press speed and cooling rate of Masahashi et al without heating the mold during the process.

Based on the above-discussed differences between the present invention and Masahashi et al, the present invention can exhibit unique effects, which cannot be achieved by Masahashi et al. Specifically, a product without a crack can be obtained by the high-speed working of the present invention. When an alloy having a superior hot-working ability (Ti-42Al-8V: at%) is subjected to high-speed working with other conditions set to those disclosed in Masahashi et al, a cracking of a test piece occurs. In support thereof, the newly-submitted Shindo Declaration shows that subjecting a test piece to homogenization heating as disclosed by Masahashi et al, i.e., an initial temperature of 1173 °K, an initial distortion speed

of 8.3 X 10^{-2} /sec, and hot-working speed of 1 mm/sec, and then to high-speed working according to the present invention, results in cracking, even if an alloy having a superior hot-working ability is used.

The initial temperature of 1173 °K is the lowest temperature at which the dynamic re-crystallization can occur as indicated by Masahashi et al. The initial distortion speed of 8.3 X 10^{-2} /sec is the value when a test piece of 12 mm in length is subjected to hot-working at a speed of 1 mm/sec which, as discussed above, is much smaller than is capable with the present invention.

In sum, the difference between the present invention and Masahashi et al lies in whether or not heating of material during plasticity processing is performed and the processing speed.

Masahashi et al discloses the use of dynamic recrystallization at distortion speeds, i.e., strain rates, of 5 X 10^{-5} /sec to 0.5/sec in processing (column 6, line 23ff). In the Examples, material is processed at a low distortion speed of 10^{-4}/sec, and the temperature is controlled with a heating and heat retention device during processing. This method is low in productivity (as the processing requires several hours) and is not suitable for industrial application.

On the other hand, the present invention does not limit the distortion speed and allows processing at high speeds. Masahashi et al does not allow high-speed hot forging of the type discussed above as the materials used, by their nature, cannot be transformed at high speeds and would be cracked. Furthermore, when the materials are taken out of the furnace for forging with a forging machine having no heating and heat retention functionality, the temperature around the area of the materials which contacts a mold will drop sharply as soon as the materials are placed on the mold, but their capability to transform is not high even at

low temperatures. This is an unanticipated effect of the present invention, which cannot be achieved by Masahashi et al.

For all the above reasons, it is respectfully requested that this rejection be withdrawn.

All of the presently-pending claims in this application are believed to be in immediate condition for allowance. Accordingly, the Examiner is respectfully requested to pass this application to issue.

Respectfully submitted,

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